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ABSTRACT

The major developmental goal of the Keyboarding, Reading, Spelling (KRS) program was to teach reading and language skills to elementary school students by integrating computer assisted instruction with an instructional method which: is superior to existing programs; takes maximum advantage of the computer's potential; and teaches keyboarding and computer usage skills. The KRS program incorporates systematic instruction in reading and language skills, diagnosis of student learning needs, monitoring, criterion referenced mastery tests, and intrinsic motivation. Teachers wishing to implement the KRS program attend a one- to two-day seminar. A pre-post comparison group design was used to assess the KRS program on each of four outcomes (reading, language, keyboarding, and computer operations). Classes from two schools in the Murray City Schools (Utah) were assigned at random to either the treatment or comparison condition. Grades one, three, and five from one school, and grades two, four, and six from another school received KRS instruction. Results indicated that in the four months of treatment, KRS students grossly out-gained the scores posted by the normative group. Results also indicated that KRS students demonstrated meaningful improvements in the keyboarding and computer operation skills. (RS)

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ED 414 558

Program Area: Microcomputers and Reading

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A. **PROJECT TITLE:** *Keyboarding, Reading, Spelling (KRS)*

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C. **YEARS OF PROJECT:** Development - 1979-83
Pilot Testing - 1983
Dissemination - 1983-86

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D. **SOURCE OF FUNDS:**
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II. PROGRAM DESCRIPTION

A. GOAL

The major developmental goal of *KRS* was to design a program for teaching reading and language skills to elementary school students by integrating computer assisted instruction (CAI) software with a proven instructional method which

— was instructionally superior to existing programs,

— took maximum advantage of the potential that computers offer while avoiding the pitfalls that have plagued previous generations of computer assisted instructional programs; and which

— fully utilized the advantages offered by the microcomputer by simultaneously teaching valuable keyboarding and computer usage skills.

B. PURPOSES AND NEEDS ADDRESSED

Computers are here to stay. They have become a part of our lives whether we asked for them or not! For the most part, we have taken good advantage of the versatility of computers. In communications, medicine, personal and corporate business, banking and a host of other

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applications, computers now make our lives easier and more efficient. In one area, however, the computer has not realized its potential -- as an effective instructional tool. No one denies that microcomputer technology holds at least as much -- if not more -- promise in the field of education as in these other areas and yet computers have not dramatically impacted our classrooms. Some of the reasons for this are as follows:

A lack of appropriate software. According to the Educational Products Information Exchange, an non-profit software review group, "Fewer than one-tenth of the 9,000 educational programs on the market are of high quality . . . and many of these are not tailored to today's curricula." Given the impact of computers, it is not enough that software is simply another instructional tool -- an over-priced set of flash cards or an electronic text book. We will only take full advantage of the potential of microcomputers when software is developed which is instructionally **superior** to other teaching tools.

The lack of teachers who are trained in the use of computers as tools of learning. This results in potentially valuable instructional time being wasted on uncoordinated activities that do not utilize the power of the computer and which often may best be accomplished by some other means.

The lack of time on task. Elementary students average only 35 minutes per week on the computer. When one considers that this time is often fragmented between several sundry applications, is it any wonder that the instructional results are mediocre?

The lack of coordination between instructional software and the instructional process. For the most part, software used in schools is an "add on" to instruction. To be truly effective, software must be designed to parallel and therefore complement instruction.

The lack of keyboarding skills in students. Simply, if the computer is ever to become a viable instructional aid, students must be able to use it efficiently. Without this skill -- a skill which is becoming essential in the workplace -- the computer can actually slow down the act of learning. Unfortunately, our elementary school teachers, already overloaded with academic mandates, do not have the time to devote to teaching students to type per se. If this is to be accomplished, it must be in conjunction with other disciplines.

KRS was developed with these factors in mind. It was felt that if such pitfalls could be overcome, the result would be powerful.

C. INTENDED AUDIENCE

KRS was designed for students at grades 1 through 6. The data presented in this document were gathered from students of average ability.

D. BACKGROUND AND THEORETICAL FRAMEWORK

The *KRS* approach integrates compatible CAI software with a proven approach to the teaching of reading and language skills. In this way, computer instruction parallels and therefore complements classroom instruction.

As *KRS* teachers teach, they utilize critical behaviors essential to effective instruction. They elicit overt responses from the learners with response rate as a measure of accuracy; instantly diagnose and prescribe when errors occur; reinforce by paying attention to appropriate behavior; integrate language skills instruction; instruct by modeling, prompting, and by fading prompts until recall is spontaneous; and they expect high levels of mastery.

When programmed with *KRS* software, the computer is also an apt instructor -- utilizing the same critical techniques in its work with learners.

— Learners respond as they strike the keys of the computer (they are also taught to verbalize as they type).

— The computer instantly diagnoses and prescribes for incorrect or no responses.

— Reinforcement is built into the program with WOWS!, SUPER SPELLERS!, shortened flashes of words, a tally of the user's score (number and percentage correct), and a variety of interesting activities.

— Language skills are completely integrated -- students spell what they read, and they type what they can read and spell. They both hear (through dictation) and read words in the context of sentences. They type capitals and periods for statements and requests, capitals and question marks for questions, capitals and exclamation marks for exclamations, semi-colons for clauses, commas for phrases, quotes for quotations and so on.

— As the teacher first models when introducing new skills, so does the computer.

— Both the teacher and the computer gradually fade prompts as students demonstrate increasingly higher levels of mastery.

E. SALIENT FEATURES

The combination of several key features make the *KRS* program both unique and innovative.

Systematic Instruction - The program teams classroom teachers with computers. In the *KRS* approach, the computer is not just a helpful tool but is central to reading and language instruction.

In a typical lesson the teacher introduces each word in the context of a sentence thus helping students to establish meaning and word use. The teacher then directs the students to read the word by blending sounds formed by the letters or by adding word parts to base words or by reading the syllables.

Vocabulary selection is based upon the keyboard sequence of letters being taught, the phonetic regularity of and the students' familiarity with the words. The first words taught are those composed of short vowels and those on the *Fry* list of most common words. After a new set of words has been learned through reading, spelling and keyboarding exercises, the words are read into a story. The stories increase in difficulty from lesson to lesson; however, words from earlier lessons are continuously reused in order to reinforce learning.

At the computer keyboard students are taught to verbalize letters, sounds and words as they type. Verbalizing the sounds associated with letters reinforces correct associations. The sequence of keyboard presentation is based on the most common usage in modern typewriting instruction. Since the program teaches the touch system, the "home row" of a, s, d, f, g, h, j, k and l is taught first. Once the letters are learned, vocabulary words associated with the home row keys are taught. As additional letters of the keyboard are mastered, new words which use these letters are introduced. Thus, students proceed through their lessons in a directed way -- typing and verbalizing a given set of letters, sounds, words and eventually sentences and paragraphs.

Activities at the computer include:

— paced reading exercises that provide reading selections to be read at one of four different speeds selected by the student

— visual memory activities in which vocabulary words and phrases are flashed on the screen and the students are required to wait, remember, and then type these words and phrases correctly

— visual timed recall activities in which students identify words which appear in timed (controlled by the students' rate of accuracy) presentations

— hand position activities which provide students with assistance in recalling the correct hand positions and fingering for newly introduced keys.

The use of these simplified and controlled activities makes it possible for the good reader to become adept in keyboarding/typing techniques rather quickly. It also makes it possible for poor readers to improve dramatically as they learn keyboarding techniques. As the students learn proper fingering, corresponding increases in reading fluency occur. The repetition required in learning the keyboard helps even those with severe reading disabilities.

Diagnosis - An accurate diagnosis of student learning needs is made by the computer. Each student's accuracy and rate of response determine the words that students will receive and the rate at which they will be presented on each succeeding activity. Having said this, the diagnosis-prescription approach can be overridden by the teacher at any time as the need arises. Teachers can create a variety of exercises by using *KRS*'s open screen capability.

Monitoring - During lesson activities, correctly pressed keys cause corresponding images to appear on the monitor. Conversely, incorrectly pressed keys cause a bell to sound and no images to appear on the screen. The student must press the correct key in order to continue. The error is counted and displayed on the monitor after the return key is pressed. The number of correct and incorrect strokes is recorded cumulatively for each lesson. At the end of the lesson, the total number of correct and incorrect responses along with the percentage of correct responses is displayed.

Criterion Referenced Mastery Tests - These tests are administered before and after each unit, providing teachers with the opportunity to individualize their instruction. If a student passes a pretest at the criterion level of accuracy and rate, he/she continues on to the pretest for the next

10-lesson unit. If the student fails a unit pretest, he/she works through the unit until mastery is attained. *KRS* includes:

— dictated mastery tests designed to assess the student's auditory ability and his/her ability to type dictated words, phrases and sentences from memory. In these tests, incorrectly pressed keys are displayed on the monitor in order that students can immediately see what they need to practice at the end of each test.

— timed keyboarding tests of words, phrases and sentences which check spelling and punctuation. The mastery criteria (accuracy and rate) for these tests are set according to the student's ability level. In this way the material stretches the student but the goals are attainable.

— activity tests in which the accuracy criterion level is set at 90%.

— pre- and posttests of computer usage and keyboarding skills.

— timed keyboarding mastery tests.

Intrinsically Motivating - *KRS* is unique among software programs designed to teach reading and/or keyboarding skills. It is thought by most developers that such software must be a game -- that it must be gimmicky and "fun" -- if it is to motivate students to learn. Obviously, these developers have not recognized how intrinsically rewarding learning is. *KRS* is not a game and yet students are eager to continue with the program because they learn from it.

III. POTENTIAL FOR TRANSPORTABILITY

A. TRANSPORTABLE COMPONENTS AND DOCUMENTATION

KRS learning materials are packaged in a looseleaf binder and include the following:

1. Four computer disks which carry such reading, language and keyboarding activities as

   — hand position exercises;
   — lessons in keyboarding techniques and reading/spelling skills (for each lesson, the student selects one of two activities -- keyboarding for reading and spelling or keyboarding for speed and accuracy);
   — visual memory activities;
   — visual recall activities;
   — paced reading activities;
   — activities for reading and keyboarding symbols and numbers;
   — drills for keyboarding letters, words, phrases, and sentences;
   — number lessons;
   — symbol lessons; and
   — mastery tests.

C

2. Comprehensive instructions for teaching computer usage, keyboarding on a computer, reading and language usage

3. Printed stories with pictures and "silly sentences" for practice reading that accompany the lessons

4. Typing drills for use
   — with the computer on and using a mastery-test lesson (the typed copy is displayed on the monitor),
   — with typed copy,
   — with the computer off (the student practices fingering as the teacher dictates)

5. A scope and sequence chart of skills and vocabulary words which are introduced in the *KRS* lessons

6. A reproducible Student Record Form for recording the dates and the results of the students' performance on each activity (providing a continuous record of achievement in reading, spelling and typing)

7. A Teacher Record Form to record data from mastery testing

8. A set of Pre- and Posttests (described earlier)

9. Replicas of Apple or IBM computer keyboards for practice at the desk.

The software runs on the Apple II plus, Apple IIe, Apple IIc, Apple IIgs, Macintosh, and IBM PC compatible computers and requires a single disk drive and DOS 3.3; a color monitor is preferred but not required.

B. USER REQUIREMENTS

Teachers wishing to implement the *KRS* approach are required to attend a one- or two-day seminar in which they are introduced to the *KRS* approach to teaching reading, language, spelling, computer usage and keyboarding skills. During the seminar, teachers are provided with hands-on experiences using the computer and the *KRS* software; they are taught how to schedule time; and they learn how to manage the record keeping system.

Each teacher should have a *KRS* manual. No special staff or facilities are required. When fully implemented, the program does, however, require that students have access to microcomputers for approximately 30 minutes each day for a minimum of 45 days. The compatibility of *KRS* with a typical school curriculum makes it readily adoptable by all elementary schools.

C. COSTS

ITEM	INSTALLATION YEAR	SUBSEQUENT YEARS
Personnel	-0-	-0-
Training	$475 honorarium	-0-
Facilities	-0-	-0-
Equipment	Microcomputers	-0-
Materials and Supplies		
Consumable	$45.95 / computer lab	-0-
Non-consumable manual and software	$180 / teacher OR as Lab Pack $468 / 5 teachers or $93.60 / teacher	-0-
TOTAL COST*	$988.95	-0-
COST PER STUDENT*	$7.91	-0-

* For a typical adoption for five teachers with 25 students per class

IV. EVIDENCE OF EFFECTIVENESS

A. CLAIMS OF EFFECTIVENESS

1. Elementary students (grades 1-6) receiving 45 hours of KRS instruction, will demonstrate significantly greater gains ($p<.01$) on standardized measures of reading and language ability than comparable non-treatment students receiving 45 hours of regular reading and language instruction.

2. Elementary student (grades 1-6) will acquire meaningful computer operation and keyboarding skills as a result of participation in the KRS program for a period of eighteen weeks.

B. DESIGN

The evaluation of the *KRS* program used a pre-post comparison group design to assess project impact on each of the four outcome variables (reading, language, keyboarding and computer operations).

C. SAMPLE

The data offered as evidence of effectiveness in this submittal were collected from the Murray City Schools, Murray, UT. The overall socioeconomic level of the district is lower middle class. Four of Murray's seven elementary schools are designated Chapter 1, and minorities represent 3% of the enrollment.

For the purposes of the present study, classes from two schools were assigned at random to either the treatment or comparison condition. Grades one, three and five from School A and grades two, four and six from School B received *KRS* instruction.

D. INSTRUMENTATION

The reading and language subscales of the *Metropolitan Achievement Test* (Form JS, 1978) provided the measurement tools for the basic skills component of *KRS*. The *Metropolitan* was selected because of its broad coverage of accepted reading and language learning objectives and its validity to the *KRS* model. Psychological Corporation, the publishers of the *Metropolitan*, cite KR20 reliabilities of .85 and .81 for reading and language respectively.

A generally accepted method of assessing typing skills (number of correct strokes/minute) was used to evaluate the *KRS* keyboarding objective. Here, the total number of errors made in typing an alphabetic sentence (in one test) and a paragraph (in a second test) was subtracted from the total number of keystrokes (including spaces) made over a one minute period to yield a gross score. This score was then divided by five to provide the standard metric of words per minute. The data included in this report represent the best score out of the two trials on each of the sentence and paragraph test forms. This technique has obvious face validity for the intervention.

To assess its computer operation objective, *KRS* used a project-developed instrument designed to assess the degree to which students could find their way around the machine, follow monitor instructions, and complete general computer operations tasks. This measure consisted of 20 items which described essential computer skills. One point was awarded for each skill that the student could successfully complete making the range of possible scores 0 to 20.

E. DATA COLLECTION PROCEDURES

Pretests were given to both treatment and comparison group students on 1/7/86. Following testing, treatment group students received *KRS* instruction in place of their regular language and reading curriculum. Comparison classes received their regular language arts instruction and the same amount of computer time (30 minutes per day/4 days per week) as the treatment group. Total instructional time was the same for both groups. Posttest were given on 5/13/86.

All possible measures were taken to ensure the reliability and consistency of the testing procedures in order to minimize testing effects. Standardized tests were administered according to the publisher's recommended procedures and similarly strict protocols were followed for the keyboarding and computer operations measures. Here, carefully written and rehearsed test administration instructions were followed by a single independent examiner without knowledge of the students' group affiliation.

F. DATA ANALYSIS

Metropolitan reading and language raw scores were converted to scale scores using the publisher's tables. Keyboarding and computer operations scores were analyzed in their raw form. Correlated t-Tests were used to contrast the pre- and posttest mean scores for each of the grade level groups. The interaction effect in a two-way ANOVA with repeated measures was examined to determine if the presence or absence of the *KRS* intervention differentially affected the treatment and comparison groups. Probability levels were set at .01. All data were analyzed by an independent evaluator.

G. RESULTS

Summary data by grade level and group for reading and language are presented in Tables 1 and 3 respectively. As can be seen, significant growth ($p<.01$) was demonstrated by each of the grade-level groups in the treatment condition on both of the criterion measures. Further, the mean gain for the treatment group was at least twice that for non-treatment students in each of the 12 comparison counterparts by at least one-half of a standard deviation. In a two-way ANOVA (repeated measures) the differential treatment effect was manifested in classic significant ($p<.01$) interactions (condition x tests). These results are presented in Tables 2 and 4.

TABLE 1: Means, Standard Deviations, Mean Gains, and t-Tests for Correlated Data for Treatment and Comparison Groups on *The Reading Subscale* of the *Metropolitan Achievement Test (Form JS)* in Scale Scores

			Pretest 1/7/86		Posttest 5/13/86				
Grade	Group	N	x	s	x	s	x gain	t	p
1	C	22	466.54	60.80	553.72	59.91	87.18		
	N		*399.90*	*80.80*	*512.60*	*91.50*	*112.70**		
	T	22	432.86	56.04	625.91	36.61	193.05	21.47	.01
2	C	18	639.38	58.24	650.55	56.25	11.17		
	N		*567.30*	*88.10*	*617.80*	*76.50*	*50.50*		
	T	18	602.50	68.94	662.56	70.06	60.06	5.51	.01
3	C	21	661.43	54.59	665.24	54.60	3.81		
	N		*641.60*	*74.10*	*653.40*	*73.10*	*11.80*		
	T	20	680.20	49.62	722.60	47.68	42.40	5.24	.01
4	C	22	717.59	56.41	724.46	54.92	6.87		
	N		*666.40*	*73.80*	*693.00*	*74.10*	*26.60*		
	T	20	691.70	60.57	734.45	66.64	42.75	5.57	.01
5	C	18	724.33	23.32	737.00	30.45	12.67		
	N		*701.60*	*74.80*	*721.20*	*78.30*	*19.60*		
	T	23	746.65	40.20	803.43	56.58	56.78	7.36	.01
6	C	22	798.14	68.28	794.27	68.16	-3.87		
	N		*725.60*	*79.40*	*744.70*	*84.20*	*19.10*		
	T	23	755.09	72.09	797.69	78.44	42.60	5.44	.01

*mean scale score gain of norm group for seven month period
C = comparison; N = norm group; T = treatment group

TABLE 2: Groups X Tests Interactions from 2-way ANOVA with Repeated Measures for *KRS* Reading Data (Scale Scores)

GRADE	WITHIN BLOCKS DF	MEAN OF SQUARES	F	PROB
1	44	61639.10	45.2752	0.001
2	36	10755.60	9.4547	0.004
3	41	7144.20	14.4267	0.001
4	42	6501.44	11.9311	0.002
5	41	7462.35	23.6389	0.001
6	45	11115.00	19.9840	0.001

TABLE 3: The Language Subscale of the *Metropolitan Achievement Test (Form JS)* in Scale Scores

			Pretest 1/7/86		Posttest 5/13/86				
Grade	Group	N	x	s	x	s	x gain	t	p
1	C	22	379.32	72.28	449.36	89.38	70.04		
	N		*335.40*	*89.00*	*410.20*	*109.10*	*74.80**		
	T	22	368.05	71.29	564.50	69.62	196.45	14.26	.01
2	C	18	579.56	61.16	598.56	71.28	19.00		
	N		*467.80*	*109.90*	*511.20*	*100.70*	*43.40*		
	T	18	500.72	115.75	608.50	115.03	107.78	7.06	.01
3	C	21	559.86	92.44	589.71	95.70	29.85		
	N		*536.30*	*97.90*	*574.20*	*121.00*	*39.90*		
	T	20	594.55	73.65	702.15	74.63	107.60	8.72	.01
4	C	22	702.18	72.89	717.27	95.31	15.09		
	N		*587.50*	*119.80*	*639.00*	*121.50*	*51.80*		
	T	21	623.28	108.58	723.29	118.05	100.01	10.29	.01
5	C	18	730.39	64.30	723.94	61.54	-6.45		
	N		*648.90*	*103.20*	*677.90*	*110.30*	*29.00*		
	T	23	738.00	43.33	786.39	35.42	48.39	7.09	.01
6	C	22	792.36	104.82	764.82	112.91	-27.54		
	N		*684.00*	*111.90*	*703.60*	*120.30*	*19.60*		
	T	23	735.17	81.48	783.30	76.31	48.13	9.27	.01

*mean scale score gain of norm group for seven month period

TABLE 4: Groups X Tests Interactions from 2-way ANOVA with Repeated Measures for *KRS* Language Data (Scale Scores)

GRADE	WITHIN BLOCKS DF	MEAN OF SQUARES	F	PROB
1	44	87885.90	30.6476	0.001
2	36	35466.70	17.8654	0.001
3	41	29108.50	23.5483	0.001
4	43	40129.70	25.1970	0.001
5	41	11704.50	20.3521	0.001
6	45	32378.90	30.2322	0.001

Tables 5 and 6 present summary data describing the effects of the *KRS* intervention on keyboarding and computer operations skills. Once again, *KRS* students showed significant ($p<.01$) growth on these variables. For keyboarding, treatment student growth exceeded one full standard deviation and outstripped the comparison group gain by an average of over 200%. For computer operations, the effect was even more powerful with treatment group growth exceeding 4 standard deviations at each grade level.

TABLE 5: Keyboarding Summary Data

			Pretest 1/7/86		Posttest 5/13/86				
Grade	Group	N	x	s	x	s	x gain	t	p
1	C	21	11.29	4.25	17.21	6.27	5.92		
	T	23	9.33	3.91	19.83	6.06	10.50	10.99	.01
2	C	19	19.55	6.02	30.95	7.83	11.40		
	T	21	19.61	7.11	37.69	12.35	18.08	10.73	.01
3	C	24	23.81	5.77	30.00	6.08	6.19		
	T	21	32.00	7.48	42.64	11.22	10.64	7.82	.01
4	C	23	34.93	7.82	44.30	8.19	9.37		
	T	20	33.55	8.83	60.45	20.90	26.90	7.82	.01
5	C	19	39.71	12.84	48.29	15.00	8.58		
	T	21	43.76	10.93	66.29	25.08	22.53	5.95	.01
6	C	21	50.02	22.08	85.05	27.27	35.03		
	T	20	43.75	14.08	115.60	83.26	71.85	4.37	.01

TABLE 6: Computer Operations Summary Data

			Pretest 1/7/86		Posttest 5/13/86				
Grade	Group	N	x	s	x	s	x gain	t	p
	C	19	0.00	0.00	1.79	0.98	1.79		
1	T	19	0.00	0.00	12.32	1.20	12.32	44.57	.01
	C	21	3.57	2.20	6.95	2.13	3.38		
2	T	19	5.21	1.55	12.95	1.72	11.12	19.53	.01
	C	16	0.00	0.00	3.88	1.78	3.88		
3	T	23	0.83	1.07	13.17	0.84	12.34	42.25	.01
	C	25	7.08	1.80	9.24	1.36	2.16		
4	T	22	5.91	1.99	14.45	0.73	8.54	19.00	.01
	C	18	0.00	0.00	7.88	1.81	7.88		
5	T	21	2.66	2.03	14.00	0.00	11.34	25.54	.01
	C	23	6.74	1.14	9.22	0.67	2.48		
6	T	23	7.91	1.08	14.13	0.81	6.22	19.41	.01

H. INTERPRETATION, DISCUSSION AND SIGNIFICANCE OF RESULTS

The data clearly demonstrate the statistical superiority of the *KRS* approach to the teaching of reading and language when contrasted with a typical regular classroom approach. The use of a pre-post/comparison design minimized the possibility that the observed growth was due to factors other than the treatment. Although random assignment of students to conditions was not possible, intact classrooms were assigned at random. This, coupled with the consistency of the results across six grade levels, provides strong testimony to the reliability of the effect.

In order to determine the practical significance of the intervention, reading and language data are contrasted with data from normative Fall and Spring testing in Tables 1 and 3. A perusal of the gain scores reveals that in four months *KRS* students grossly outgained the scores posted by the normative group in a seven month period of regular classroom intervention.

Over and above strong growth in the basic skills of reading and language, *KRS* students demonstrated meaningful improvements in the keyboarding and computer operations skills. Following instruction, these students were able to type an average of over 25 error free characters per minute more than they could before *KRS* and approximately 15 more error free characters than students who used a leading commercial keyboarding program for the same amount of time. In addition, as a result of the treatment, *KRS* students were able to perform a substantively greater number of standard computer operations. Both of these skills are becoming increasingly important for students as we move into the technology and information age.

In summary, the data described in this document provide strong testimony to the positive effects of the *KRS* program on the reading, language, keyboarding and computer usage skills of elementary school students. The program is unique in its approach, innovative and timely. *KRS* is cost effective and readily transportable to most elementary school settings.